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ANALYTICAL RESULTS REPORT
COLLEGE OF THE CANYONS SMELTER SITE
CANON CITY, COLORADO
TDD #T08-9410-014

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1.0 INTRODUCTION

Under authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Superfund Amendment and Reauthorization Act of 1986 (SARA), and in response to Region VIII U.S. Environmental Protection Agency (EPA) Technical Direction Documents (TDD) #T08-9406-008 and #T08-9410-014, the Ecology and Environment, Inc., (E & E) Technical Assistance Team (TAT) was tasked to perform a site inspection at the College of the Canyons Smelter site, CERCLIS ID # COD116263781, located near Canon City, Colorado.

This Analytical Results Report (ARR) was prepared to partially fulfill the requirements of the referenced TDDs. From August 15 through August 31, 1994, a site inspection was conducted at the College of the Canyons Smelter Site in Canon City, Colorado. The site inspection was conducted pursuant to the Sampling QA/QC Work Plan approved by the EPA on August 12, 1994. A Sampling Activities Report (SAR) detailing the activities of the site inspection was submitted on October 10, 1994. This ARR provides the analytical results for the samples collected during the site inspection and subsequently described in the SAR.

2.0 OBJECTIVES

Air, water, soil, and sediment samples were collected at the College of the Canyons Smelter site to accomplish two objectives:

- to obtain the essential data needed to rank the site using the Hazard Ranking System (HRS) by characterizing the waste source and the pathways by which the waste has traveled if a release from the waste source has occurred; and
- to determine if threats to human health or impacts to the environment exist at the site. This objective will be accomplished through characterization of the waste source and pathways in combination with target population information.

High volume air sampling (hi-vol) was used to measure the metal content of suspended particles in the air, thus confirming whether or not metals were being released to the air pathway from the waste source. TAT members Sullivan and Straub conducted the hi-vol sampling from August 16 to August 19, 1994, and from August 23 to August 25, 1994. Samples collected during this event for analysis of ICP metals using QA level II, were delivered to CKY Laboratories in Wheat Ridge, Colorado on August 22 and 26, 1994. Soil samples were collected to characterize the waste source, and sediment samples were collected to characterize the migration of contaminants from the waste source via the water pathway. Soil and sediment samples for field screening and HRS scoring were collected by TAT members Alexander and Mayer from August 23 to August 25, 1994. On August 31, Alexander and Sullivan collected sediment samples. The field screening samples were analyzed by a TN Technologies Spectrace 9000 XRF spectrometer. The HRS samples were delivered to CKY Laboratories on September 13, 1994, for cyanide and/or Hazardous Substance List (HSL) metals using QA level II criteria.

Surface water samples were collected to determine if releases from the waste source were entering the Arkansas River. There are three ditches carrying run-off from the site. These ditches join Forked Gulch at a point north of the site. Forked Gulch then continues to flow north approximately 1 mile, where it enters the Arkansas River (Figure 7). Sampling along the water pathway was conducted by TAT members Alexander and Sullivan on August 31, 1994. The samples were delivered to CKY Laboratories on September 13, 1994, for HSL metals analysis using QA level II criteria.

3.0 SITE DESCRIPTION

3.1 Site Location and History

The College of the Canyons Smelter site encompasses approximately 60 acres and is located 1.5 miles south of the Arkansas River in Canon City, Colorado. The waste on the site consists of tailings, dirt, and slag that contain high levels of metals. The coordinates of the smelter stack, which remains standing, are 38° 24' 43" North latitude and 105° 14' 58" West longitude. The legal site description is the northwest quarter of Section 8, Township 19 South, Range 70 West (Figure 1).

3.2 Background Information and History

The College of the Canyons Smelter Site operated under the direction of the New Jersey Zinc Company. The smelter processed ore particularly rich in zinc and lead that was obtained from the Eagle Mine and Mill in Gilman, Colorado. The smelter operated from 1902 to 1968, and was capable of processing 90 tons of ore per day. After the smelter closed in 1968, the site was purchased by the Canon City Chemical Company, which used the mineral-rich tailings as a soil additive. The operations of the chemical company continued until 1991.

In May 1991, the Emergency Response Branch (ERB) of the EPA removed 155 drums from the site because of potential threats to the environment. At that time, the EPA did not address contaminated soils, waste rock, and tailings from smelter activities. In June 1994, the EPA-ERB and the TAT performed a reconnaissance survey of the smelter site, which included X-ray fluorescence analyses of 17 soil samples. In a majority of the samples collected from on-site soils and waste piles, analyses revealed elevated levels of several metals, including cadmium, lead, mercury, and zinc.

4.0 FIELD ACTIVITIES

4.1 Sample Collection and Field Observations

4.1.1 Air Sampling

TAT members Sullivan and Straub conducted the hi-vol air sampling. Eight hi-vol stations were established to determine a possible release via the air pathway (Figure 2). Five of the eight hi-vol stations were within a zero to 1/4-mile radius of the site. Three of the stations were located north of the site. Two of these stations were placed side-by-side to obtain duplicate samples for QA/QC. The remaining stations within a 1/4 mile radius were located at the College of the Canyons Campus and the Fremont County Business Development Complex. Three hi-vol stations were located at businesses or operations within a 1/4- to 1/2-mile radius of the site. These businesses or operations were the Colorado State Forest Service Shops, Fremont Auto Salvage, and the BFH Transfer Station.

The initial step in the operation of the high-volume air samplers (hi-vols) was calibration of the units with a calibrated variable flow orifice. Once calibrated, air flow through the units could be adjusted or calculated based on a manometer reading. Because accurate measurement of the meteorological conditions is important in the calibration and adjustment of hi-vol units, a portable meteorological (met) station, capable of measuring temperature, humidity, barometric pressure, and wind direction and speed, was erected on site. The meteorological station is capable of continuous readings that can be stored and downloaded to a computer at a later time.

The hi-vol units were operated for five 24-hour periods, during which they drew 50 cubic feet of air per minute (cfm). On August 19, 1994, after the third 24-hour period, operations were suspended due to a heavy rain storm that caused street flooding in Canon City. Had hi-vol operations continued, results would have shown a drastically reduced number of suspended particles in the air for the next 24 to 48 hours. Air sampling resumed on August 23, 1994, and concluded on August 25, 1994, thus completing the five 24-hour sampling periods.

The suspended particles collected were drawn into the hi-vol unit and trapped by Whatman 41 cellulose 8" x 10" filters. To ensure that the filters were not cross-contaminated, dedicated gloves were used to install and remove the filters, and each filter was stored in a dedicated envelope. Manometer readings were taken at the beginning and end of each sampling period. Before a new sampling period was started, the hi-vol units were decontaminated with a damp cloth to remove particles from the previous sampling period. The hi-vol units were also secured to prevent them from being opened, which would potentially contaminate the filters.

A sampling period was defined as 24 hours; consequently, five filters were used in and collected from each of the eight hi-vol stations over the course of the 5-day sampling period. The sampling filters were delivered to CKY for ICP metals analysis. Table 1 contains additional information about air sampling activities.

4.1.2 Soil Sampling

From August 23 to August 25, 1994, fifty-five soil samples were collected by TAT members Alexander and Mayer (Figure 3). Sampling was biased, but a sufficiently large number of samples was collected to ensure a dependable representation of the site. All soil samples were collected with dedicated teflon scoops and were placed into plastic bags which were then secured with tape. The sealed sample bags were placed in a cooler with ice for sample preservation.

Of the 55 soil samples, 10 were split and subsequently delivered to CKY Laboratories for HSL metals analysis using QA level II criteria. Figure 4 illustrates the locations from which the split samples were collected. The 10 samples selected for metals analysis were pre-screened by a TN Technology XRF Lead Analyzer, which is capable of analyzing for iron, copper, zinc, lead, arsenic, and manganese. The samples selected for analysis contained a broad spectrum of metal concentrations.

Most of the soil samples were surface samples, although five samples (CC-XRF-041 through CC-XRF-045) were collected by a hand auger from a depth of 18" below ground surface (bgs). Four of these samples were split and delivered to CKY Laboratories for HSL metals and cyanide analyses using QA level II criteria. These four samples and their corresponding splits were as follows: CC-XRF-41 (CC-SO-10); CC-XRF-42 (CC-SO-11); CC-XRF-43 (CC-SO-12); and CC-XRF-45 (CC-SO-13).

In addition to laboratory analyses, all soil samples were analyzed for 21 metals with the Spectrace 9000 XRF spectrometer. The analyses were conducted under QA Level I screening criteria.

The types of soil samples collected can be categorized into three groups:

- those obtained from tailings, obvious because of their dark red, grayish, or orange color;
- those collected from around building foundations, such as in the area believed to be the location of the assay office; and
- those obtained from locations where the soil appeared to be normal, or uncontaminated.

The uncontaminated soil samples served as background samples CC-XRF-030 (CC-SO-01) and CC-XRF-029 (CC-SO-02). The sample number in parentheses is the number of the sample that was obtained through splitting and was sent to a laboratory for QA level II analysis. Table 1 contains additional information about soil samples.

4.1.3 Sediment Sampling

Thirty sediment samples were collected on August 31, 1994, by TAT members Alexander and Sullivan (Figure 5). Three ditches carrying run-off from the site join Forked Gulch just north of the site; Forked Gulch then continues north to the Arkansas River. From an area just north of the site to the Arkansas River, Forked Gulch is a potential wetlands area.

Samples were obtained from the three on-site ditches, from Forked Gulch, and from the Arkansas River. Sample CC-XRF-112 (CC-SE-16), collected upstream in the Arkansas River, serves as a background sample. Samples CC-XRF-137 (CC-SE-01) and CC-XRF-139 (CC-SE-02) were collected upstream of the site from two of the three ditches. These samples also serve as background samples.

The procedures by which the sediments were collected and selected for analysis were identical to those used for the soil sampling procedures. Of the 30 sediment samples, 16 were split (Figure 6) and selected for HSL metals and cyanide analyses using QA Level II criteria at CKY laboratories. In addition to the QA level II analyses, the 30 samples were analyzed for 21 metals using QA level I criteria with the Spectrace 9000 XRF spectrometer.

Four additional sediment samples (CC-XRF-101 through CC-XRF-104) were collected by TAT members Alexander and Mayer from August 23 to August 25, 1994. These samples were collected from on-site locations where evidence of standing water existed. These samples were analyzed by the Spectrace 9000 XRF spectrometer under QA level I criteria. Table 1 contains additional information about sediment samples.

4.1.4 Surface Water Sampling

The majority of surface water samples were collected by TAT members Alexander and Sullivan concurrent with rainfall on August 31, 1994. Sample collection began at the Arkansas River and continued upstream into the drainage ditch to just north of Valley Road (Figure 7). TAT members Alexander and Mayer collected water samples CC-SW-18 and CC-SW-19 on August 23 and 25, 1994, respectively. These two samples were collected from standing puddles of water outside the drainage ditches. Surface water sample CC-SW-02, collected upstream in the Arkansas River, served as the background sample.

The pH of the surface water samples was field screened with pH paper. Samples CC-SW-16 through CC-SW-19 possessed a relatively acidic pH of 2. Samples CC-SW-12 and CC-SW-13 were mildly acidic with a pH of 6, and the remaining samples exhibited a pH of 7.

The 19 surface water samples were collected in 1-liter polyethylene containers, preserved to pH 2 with nitric acid, and stored on ice. The samples were then delivered to CKY Laboratories where they were analyzed for HSL metals using QA level II criteria. Table 1 contains additional information about surface water samples.

4.1.5 Surveying

A surveying station was established at the northwest corner of section 8. The coordinates of all soil samples and the hi-vol stations on or near the site were obtained with the surveying station. Because of time restrictions and the distance over which the sediment and surface water samples were obtained, coordinates for these sample locations were not obtained, but the approximate location of these samples were plotted on an aerial photograph of the site. In addition to sample locations, site structures and site topographic features were also surveyed to enable creation of a site drawing; however, the site boundaries indicated on each sampling map are approximate.

4.1.6 Non-Sampling Data Collection

It is unlikely that drinking water near the site has been contaminated by the site. Although applications and permits for wells near the site exist, only one well, located approximately

3/4 of a mile north/northeast of the site, is hydrologically downgradient from the site. Because of the availability of municipal water, it is unlikely that ground water is used for drinking water within 2 miles of the site.

There are no residences within 1/2 mile of the site. There are, however, several businesses. Businesses support 40 to 55 workers within 1/4 mile of the site, and 175 to 220 workers within 1/2 mile of the site. There are few residences within a 1-mile radius of the site. Much of Canon City is contained within a 4-mile radius of the site. As many as 12,000 to 15,000 people, based on population densities of Canon City, Lincoln Park, and Brookside, reside within a 1/2-mile to 4-mile radius of the site.

4.1.7 Field Observations

The site served as an smelter/ore processing plant. There are numerous tailing piles on the site, which are easily recognized by their dark red, orange, and/or gray colors. Pyrite crystals are abundant on the site, which is indicative of and consistent with the low pH of the standing water. The sulfur in the pyrite is oxidized to sulfuric acid, consequently lowering the pH of the water. The surface of the tailings is hard and crusty when dry. Although the wind was blowing during sampling periods, it did not appear to create a significant amount of dust.

In accordance with criteria outlined in the Code of Federal Regulations, Forked Gulch may be considered a wetland. Wetlands are comprised of areas saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. During a walk-through of Forked Gulch on August 25, 1994, TAT members Alexander and Mayer observed water seeping into Forked Gulch. Water was observed seeping from the points where samples CC-SW-13 and CC-SW-14 were taken to the Arkansas River. The amount of seeping water generally increased as Forked Gulch continued north toward the Arkansas River. Because substantial precipitation had not fallen in the previous 48 hours, it can be reasonably concluded that the area near Forked Gulch is saturated with ground water. This conclusion is further supported by the types of vegetation growing near Forked Gulch. As illustrated in several on-site photographs, the most obvious sign of soil saturated with water are the phreatophytic cottonwood trees.

4.2 Quality Assurance/Quality Control

Quality assurance/quality control was maintained in accordance with the *Emergency Response Branch Quality Assurance Plan*. Where dedicated equipment was not used to collect samples, TAT maintained the integrity of the samples by following extensive decontamination procedures. The sample containers used during this investigation included 1-liter polyethylene bottles for the surface water samples and small plastic bags or glass jars for the soil and sediment samples. The cellulose filters used for the air sampling were stored in dedicated envelopes. The surface water samples were preserved with nitric acid. Upon completion of a sampling event, samples were sealed in their container, labeled, and sample information was recorded in one of the site log books.

Duplicate and spiked sample analyses were conducted with each of the sample delivery groups. The results of these analyses are contained in the data validation reports (Appendix C). The background samples were compared with the data produced from sample analysis of potentially contaminated locations. Sample CC-SW-02, obtained upstream in the Arkansas River, is the background samples for the surface water samples. Sample CC-SE-02 is the background sample for most of the soil and sediment samples and was obtained from a drainage ditch upstream from the site. The other sample used for sediment background levels was CC-SE-16, which was obtained from upstream in the Arkansas River. CC-SE-02 was used for background levels because the samples originally planned to be used as the soil background samples were more contaminated than anticipated. The background samples for the air sampling varied on a daily basis and were determined based on the predominant wind direction over the previous 24-hour sampling period.

After collection, all samples were handled by rigidly following chain-of-custody protocol prescribed by the *NEIC Procedures Manual for the Evidence Audit of Enforcement Investigations by Contractor Evidence Audit Teams*, April, 1984 and *NEIC Procedures Manual for the Contract Evidence Audit and Litigation Support for EPA Enforcement Case Development*, February, 1989.

5.0 WASTE/SOURCE CHARACTERISTICS

5.1 Waste/Source Description

The College of the Canyons Smelter site consists of approximately 60 acres of land. The waste consists of tailings distributed randomly over the site. Based on field observations and historical data, the tailings are expected to have elevated levels of various metals, and in particular, lead and zinc. The Eagle Mine, from which the ore was transported, is also known to have a high sulfur content, which was substantiated by the presence of pyrite in the tailings.

5.2 Sample Locations

To characterize the waste, soil samples were collected extensively over the site. Fifty-five soil samples were collected, 50 of which were surface samples, and five of which were subsurface samples taken from a depth of 18 inches bgs. As Figure 3 shows, samples were collected from tailing piles, near building structures, and in areas that appeared to be uncontaminated. Samples CC-SO-01 (CC-XRF-030) and CC-SO-02 (CC-XRF-029) were collected as background samples, but analyses of these samples indicated unnaturally high levels of metals. Consequently, sample CC-SE-02, which was collected from a drainage ditch near the site, was used to establish the background levels for the waste source soil samples.

5.3 Analytical Results

There are two sets of analytical results for the soil samples collected. The first set of results consists of the screening data obtained via the Spectrace XRF instrument, while the second set of results consists of the data obtained from the laboratory under QA level II criteria. The XRF results are presented in Table 5 and Appendix E, and the laboratory confirmation results are presented in Table 3. Appendix E provides the XRF raw data, and Table 5 gives the results for zinc and lead.

To determine the precision and accuracy of the XRF analyses, a statistical analysis was conducted (accuracy represents how close the average value of all the measurements

comes to the true value, while precision represents how close in value all of the measurements are to each other). In calculating the percent recoveries presented in Table 7, the laboratory analysis was assumed to be the true value. The statistics presented in Table 8 are categorized into different level ranges to reflect instrument behavior; the XRF is expected to produce measurements with greater accuracy over certain ranges. For instance, the percent recovery of lead from 100 to 1,000 parts per million (ppm) and from 1,000 to 10,000 ppm were 81% and 69%, respectively. Thus, the analyses of lead from 100 to 1,000 ppm are more accurate.

The precision of the analyses can be judged from the standard deviation values. From the standard deviation, the analyses for lead above the level of 10,000 ppm are judged to be the most precise. The standard deviation can also be used to give confidence intervals. The first confidence interval (i.e., ± the standard deviation from the average) represents the 68.3% confidence interval. In other words, 68.3% of all the XRF measurements for lead in the range of 1,000 to 10,000 ppm can be expected to have percent recoveries between 52% and 86%. The second confidence interval (i.e., ± two times the standard deviation from the average) represents the 95.4% confidence interval. Thus, 95.4% of the measurements for lead in the range of 1,000 to 10,000 ppm can be expected to have percent recoveries between 35% and 103%.

The bias of the samples (i.e., high or low) can be corrected by using the value given in the multiplier column in Table 8. Lead values that were greater than 10,000 ppm only had an average percent recovery of 54%, which is indicative of a low bias on the XRF measurements. To gain a value that may better reflect the true value, any XRF lead result over 10,000 ppm can be multiplied by 1.85 to *estimate* the true value of lead in the soil. For instance, the XRF analysis of sample CC-XRF-025 yielded a result of 12,000 ppm. Based upon the low bias indicated by the confirmation samples, the true level of lead in CC-XRF-025 is expected to be closer to 22,000 ppm (12,000 x 1.85 = 22,200).

The analyses (both laboratory and XRF) indicate extensive levels of lead in the soil on the site. The background level of lead for the site was established for the laboratory samples by sample CC-SE-02 at a level of 11 ppm and for the XRF samples by sample CC-XRF-139 at 78 ppm. If contamination is considered to have occurred when levels are observed to be three times above the background level, then all 14 of the laboratory samples and all

55 of the XRF samples indicate the presence of contamination. Typical contamination levels of lead are on the order of 5,000 to 10,000 ppm, while the highest level of contamination observed was approximately 100,000 ppm (10%).

Similar results were obtained for zinc. Using samples CC-SE-02 and CC-XRF-139 as background samples, zinc background levels of 14 and 86 ppm were obtained, respectively. All 14 laboratory samples and all 55 XRF samples were subsequently found to contain more than three times the background level of zinc. Typical zinc levels were commonly greater than 1,000 ppm. A few samples exceeded 10,000 ppm.

The contamination from cadmium and arsenic is extensive, but not of as large a magnitude as lead or zinc. The XRF measurements of cadmium, and in particular arsenic, are not as reliable as they are for lead and zinc. Consequently, only the laboratory samples were used to characterize the waste source. Using CC-SE-02 as the background sample, the background levels of arsenic and cadmium were found to be 0.9 and 1.1 ppm, respectively. All 14 laboratory samples indicated contamination levels for both cadmium and arsenic. Levels for arsenic and cadmium were typically less than 200 ppm, but both elements had samples in which their levels eclipsed 1,000 ppm.

For mercury, because all results lie at the detection level of the XRF instrument, the XRF results are unreliable. The laboratory analyses, with CC-SE-02 as the background sample, indicate the presence of mercury in 13 of the 14 samples. Levels of mercury were usually below 1 ppm; the highest levels observed were 3.4 ppm and 4.8 ppm.

Due to the nature of the source, other elements occur at elevated levels in some samples. These elements include antimony, manganese, vanadium, cobalt, copper, nickel, and chromium. The extent to which these elements occur, however, is limited, although several samples do indicate substantial contamination at levels greater than 1,000 ppm. Metals occurring at levels exceeding 1,000 ppm are manganese (CC-SO-07, CC-SO-10, CC-SO-11, CC-SO-12, and CC-SO-13), copper (CC-SO-06, CC-SO-09, CC-SO-10, and CC-SO-11) and nickel (CC-SO-06 and CC-SO-09).

Subsurface samples CC-XRF-041 through CC-XRF-045 were taken from a depth of 18 inches bgs. The four laboratory splits were samples CC-SO-10 through CC-SO-13. The

subsurface samples are not noticeably distinguishable from the surface samples. Nearly all the metals previously mentioned as being present at contamination levels in the surface samples are also present at contamination levels in at least one of the four subsurface samples. The only metal present at less than three times the background level in all of the subsurface samples is chromium.

5.4 Conclusions

The waste source can be described as consisting of various heavy metals. Because the tailings are unevenly distributed over the site, a wide variation in levels of metals is observed. Of all the metals, lead is of the greatest concern because of its toxicology and the consistent extent to which it has contaminated the site at relatively high levels. Cadmium, arsenic, and mercury are of toxicological concern and are also present, but not to the same extent and at the level of magnitude as lead. Two elements, iron and zinc, are present at relatively high levels, but are not of toxicological interest. Several other elements (antimony, copper, cobalt, manganese, nickel, and chromium) are occasionally present at elevated levels, but usually at relatively low levels.

6.0 GROUND WATER PATHWAY

6.1 Hydrogeology

Three general types of geologic formations underlie the College of the Canyons Smelter site. The uppermost formation consists of quaternary alluvium, which possesses a hydraulic conductivity near 0.01 cm/sec. The quaternary alluvium is underlain by several sandstone formations, each with a hydraulic conductivity of approximately 10^{-4} cm/sec. Pierre Shale, with a hydraulic conductivity of 10^{-6} cm/sec, underlies the alluvial and sandstone formations. The topography of the area dips slightly to the north, and it is expected that shallow ground water flows to the north from the site and towards the Arkansas River.

6.2 Targets

There are two targets at or near the site that are associated with ground water: wells used for domestic drinking water and a wetlands area north of the site along Forked Gulch. Due to the availability of municipal drinking water in the areas north, south, and east of the site, domestic wells do not represent a viable target. The second target, the wetlands, lies between the site and the Arkansas River. Water was observed to have been seeping from the ground along various spots of Forked Gulch. Any water seeping from the ground is potentially ground water that is transporting contaminants from the site. Due to the ground water seeping into Forked Gulch, and mixing with surface water, determining whether the ground water is contaminated without well water analysis would be difficult.

6.3 Analytical Results

Samples from ground water wells were not obtained.

6.4 Conclusions

Ground water samples were not collected for two reasons. First, the only domestic well that could be affected by ground water contamination has not been used since 1985 (as stated by the owner). The second reason ground water was not sampled is that the ground water is believed to be shallow and moving in a predominantly horizontal direction due to the sloping topography of the area. The topography slopes to the north/northeast and towards Forked Gulch and the Arkansas River. Shallow groundwater moving in a predominantly horizontal direction is consistent with the observation of ground water seeping into Forked Gulch.

7.0 SURFACE WATER PATHWAY

7.1 Hydrology

The College of the Canyons Smelter site is located approximately 1.5 miles south of the Arkansas River. Surface run-off from the site can enter one of three drainage ditches. The three ditches join Forked Gulch which then flows northward to eventually join the Arkansas

River. The three ditches near the site are intermittently dry and appear to contain flow only as a result of rainfall or melting snow. As alluded to when discussing the ground water pathway, water can be observed seeping into Forked Gulch. Even during dry periods, Forked Gulch contains water as it approaches the Arkansas River.

7.2 Targets

Although wetlands are not mapped along the drainage that leads to the Arkansas River, there are small areas that could be classified as wetlands in accordance with federal guidelines (as discussed previously in section 4.1.7). The Arkansas River below the 1st Street Bridge to Pueblo Reservoir is designated by the Colorado Department of Health and Environment, Water Quality Control Section as Class I Primary Contact Recreation, Class I Cold Water Aquatic Life, suitable for agricultural use, and as a domestic water supply. The City of Florence, located approximately 11 miles downstream from the site, receives 50% of its 2 million gallon-per-day water supply from the Arkansas River. Between Canon City and Florence, the Arkansas River has a relatively confined channel with cobble substrate that is recognized as an excellent cold water fishery. Species of special concern to the Colorado Division of Wildlife (CDOW) that inhabit this portion of the river are the red-bellied dace and the brown trout. Below Florence, the Arkansas River channel broadens and is characterized by a "transition zone" fishery containing diverse species and large numbers of fish. Bald Eagles are common to the Arkansas River below Canon City primarily during the winter months when the birds gather in large numbers in the Swallows area above Pueblo Reservoir. These wintering eagles may feed upstream as far as Canon City. This may also be true of resident osprey and great blue herons, which inhabit the Swallows area. The Swallows area is on the Arkansas River approximately 30 miles downstream from the site.

7.3 Sample Locations

To determine whether a release from the waste source had occurred via the surface water pathway, two types of samples were collected. The first group of samples were surface water samples that were collected concurrently with rainfall; the second group of samples were sediment samples. Samples were collected primarily from Forked Gulch, but some

samples were also collected from the run-off ditches just north of the site and from the confluence of Forked Gulch and the Arkansas River.

7.4 Analytical Results

Nineteen surface water samples were gathered to determine whether a release to the surface water pathway had occurred. The results are provided in Table 2. The sample that serves as the background sample is CC-SW-02. Sample CC-SW-02 was taken in the Arkansas River, upstream from where Forked Gulch joins the Arkansas River. Sample CC-SW-02 is the blank for all the surface water samples because flowing water was not available from any of the three ditches upstream from the site.

Sample CC-SW-01 was collected downstream from the confluence of Forked Gulch and the Arkansas River. Laboratory results indicate that a release into the Arkansas River is not occurring for any of the metals on the target analyte list, except for possibly lead. The release of lead into the Arkansas can be neither confirmed nor denied. The uncertainty arises because lead analysis failed QA/QC criteria. Lead failed its spiked sample recovery at 62% (see the quality assurance reports, Appendix C). In the worst case scenario, the background sample CC-SW-02, which was determined to be 3.0 μg/L, could actually be closer to 5 μg/L if the low bias is corrected. If the analysis of the background sample experienced a low bias, but the analysis of the downstream sample was accurate, then the downstream sample would be less than three times the background sample; however, if the background sample analysis was accurate and if the downstream sample experienced a low bias, then by definition a release did occur. Due to the failure of the QA/QC criteria, however, a release of lead into the Arkansas from the site cannot be addressed with a fair degree of certainty. Sample CC-SW-03, which was collected from Forked Gulch just before the confluence of Forked Gulch and the Arkansas River, did indicate the release of lead.

Releases of lead from the site to the surface waters of Forked Gulch have occurred, although there is a large variability in lead concentrations from sample location to sample location. The lowest concentration of lead along Forked Gulch occurred from the ground water seeps and from the "sewer" water influent. Because none of these samples exceeded lead levels of 5μg/L, lead concentrations in these samples were less than three

times the background level of CC-SW-02. The results of the ground water seep samples indicate that the ground water is not contaminated or that metals are not efficiently transported by the groundwater. Sample concentrations of lead for the remaining samples were usually above 50 µg/L; three samples exceeded 3,000 µg/L.

The three other metals of toxicological concern identified at the site were cadmium, arsenic, and mercury. Mercury was not detected in any of the surface water samples. Cadmium and arsenic were identified at high concentrations in several of the samples, including samples CC-SW-16, CC-SW-17, CC-SW-18, and CC-SW-19. The concentrations in these samples ranged from 4,000 µg/L to 18,000 µg/L for cadmium, and from 3,000 µg/L to 40,000 µg/L for arsenic. The locations of the four samples are within a short distance of the site; for samples located farther from the site along Forked Gulch, the concentrations of arsenic and cadmium decrease substantially. All of the sample concentrations for cadmium and arsenic fell below 100 µg/L along Forked Gulch. Several cadmium concentrations were below the instrument detection limit of 5 µg/L.

The four samples referenced above, CC-SW-16 and CC-SW-19, also showed elevated concentrations of the following elements: antimony, chromium, cobalt, copper, manganese, nickel, vanadium, and zinc. Two of these elements, cobalt and vanadium, were not identified in the earlier description of the waste source. An explanation for the elevated concentrations of the metals in these surface water samples is that the pH of these water samples was extremely acidic (pH 2). Acidic water is capable of leaching metals from the soils, and because the flow of water is intermittent at the points where the samples were collected, the metals can be concentrated due to cycles of leaching and drying. At sampling points further down along Forked Gulch, the concentrations of most of the analytes are sufficiently high to indicate a release, although their concentrations have been greatly reduced.

The second method by which a release via the surface water pathway is possible was investigated by analysis of sediment samples. The results for the sediment samples are provided in Tables 4 and 6, and in Appendix E. Sample CC-SE-16 was collected upstream of the confluence of Forked Gulch and the Arkansas River, and serves as the background sample. Based upon the analysis of CC-SE-16, sample CC-SE-15, which was collected downstream from the junction, does not indicate a release from the site. Sample CC-SE-

14, which was collected in Forked Gulch near the confluence of Forked Gulch and the Arkansas River, did indicate the release of metals. Samples CC-SE-02 serves as the background sample for sample CC-SE-14. The elements that were higher than three times the background levels for sample CC-SE-14 were arsenic, chromium, copper, iron, lead, manganese, nickel, and zinc.

Of the remaining samples, samples CC-SE-03 through CC-SE-13 indicate a release of metals from the site (sample CC-SE-01 may be considered a "dirty" background sample). Based on background sample CC-SE-02, a release of lead and arsenic occurred for samples CC-SE-03 through CC-SE-13. The highest levels of lead and arsenic in CC-SE-05 were 11,400 ppm and 330 ppm, respectively. The release of cadmium was confirmed for all of the samples except CC-SE-10. Mercury was found at levels three times above the background in samples CC-SE-04, CC-SE-05, and CC-SE-09. Other metals of significance for which a release can be confirmed are antimony, cobalt, chromium, copper, iron, manganese, nickel, vanadium, and zinc. The release was relatively large for iron and zinc.

7.5 Conclusions

Two targets were identified for the surface water pathway: the Arkansas River and the wetlands along Forked Gulch. Releases were confirmed for Forked Gulch, but could not be substantiated for the Arkansas River, although metals from sediment and surface water are probably entering the river. Samples CC-SW-03 and CC-SE-14, located just before the confluence of Forked Gulch and the Arkansas River, indicate levels of metals that are three times above their respective background levels. Due to the large flow of the Arkansas River, however, metals released from Forked Gulch are substantially dispersed or diluted.

8.0 SOIL EXPOSURE AND AIR PATHWAYS

8.1 Physical Conditions

The 60 acres of waste rock, tailings, and contaminated soils are essentially barren, i.e., little or no vegetative cover exists at the site. In addition, the waste tailings and soil are fine-grained and would appear to be susceptible to air borne migration from the site. Dusty conditions, however, have not been noted on recent visits to the site. The lack of dust

may be attributed to the ability of the soil and tailings to form a hard crust that may prevent the formation of dust. On visits to the site in 1991, the TAT did observe dusty conditions; however, at that time a fertilizer company was actively conducting business, and the vehicle traffic and the business operation probably prevented the formation of hard crust and enhanced the formation of dust. Thus, although dusty conditions may not be a current concern, they could easily recur.

Drainage ditches collect runoff from the site, but usually remain dry due to a lack of moisture. The College of the Canyons Smelter site is located in a semiarid climate zone. The mean annual precipitation is approximately 19 inches. The calculated net annual precipitation (mean precipitation less evapotranspiration) is 5.5 inches (Delaware 1986). The 2-year, 24-hour rainfall event is 1.5 inches (Dunne and Leopold 1978).

8.2 Soil and Air Targets

The soil target would primarily consist of people who are trespassing. There are no fences or other barriers restricting access to the site. Although the site is less than 1 mile from the Prospect Heights residential area of Canon City, the area is somewhat isolated by steep and irregular topography. Evidence of some foot traffic through the area exists, but inhabitation of the site or use of the site as a food source by threatened or endangered species is unlikely. With no residences within 1/2 mile of the site, the greatest soil exposure concerns appear to be unrestricted access by children, pedestrians, and recreational vehicles.

The primary air targets are workers within a 1/2-mile radius and the town of Prospect Heights, which is located within the 1-mile radius. Canon City, Brookside, and Lincoln Park are within a 4-mile radius of the site. The air target populations are summarized as follows.

Radius	Population
On site	0
0 - 1/4 mile	55 (workers)
1/4 - 1/2 mile	220 (workers)
1/2 - 1 mile	1,000
1 - 2 miles	2,500
2 - 3 miles	5,500
3 - 4 miles	6,000
The above population numbers are from field observation or are estimated based on the following population densities: Canon City: 1,606 people per square mile Brookside: 458 people per square mile Lincoln Park: 981 people per square mile	

8.3 Soil and Sample Locations

No soil exposure pathway samples were collected except for the waste source characterization samples discussed in Section 5.0.

8.4 Air Monitoring

8.4.1 Methodology

All air sampling stations were set up to sample in the breathing zone and were located in accordance with the approved sampling plan. The meteorologic station was set up between hi-vol sampler location 1 (HV-1) and locations HV-4 and HV-5. The wind vane was calibrated to true north. The meteorologic station recorded air temperature, barometric pressure, relative humidity, wind speed, and wind direction. This information was used to correct sampler flow rates and air concentrations to standard temperature and pressure conditions (STP).

The samplers were calibrated in place using a General Metal Works variable orifice calibrator. Calibration records are included in Table 10. The samplers were set to run for 24 hours at approximately 50 cfm.

All samplers were equipped with elapsed timers to record the total sample time. Each hi-vol was also equipped with a flow recorder that measured the flow throughout the sample period. Any fluctuations in flow during the sample period would be noted on the recorder disk. The flow recorder also served as a check on the elapsed timers.

8.4.2 Quality Assurance

The air samples were analyzed for metals and total suspended particulates (TSP). The analytical data were found to be of good quality with two exceptions. The TSP results, as explained the quality assurance report (Appendix C), were rejected due to poor precision in the measurements of the filter paper. Before and after the collection of the TSP on the filter paper, each filter paper was weighed a minimum of three times. The standard deviation of the measurements was calculated and determined to be 0.01 g. The typical mass of the TSP collected during a 24-hour sampling period was on the order of 0.02 to 0.04 g. Given that the standard deviation was consistently 25% to 50% of the analytical result, the TSP results were rejected.

Because the TSP results failed QA/QC criteria, zinc levels were used to gauge the amount of particulates released from the site. Unfortunately, some of the analyses for zinc failed QA/QC criteria as well. Filter blanks were analyzed with each sample delivery group. In the second sample delivery group, the filter blank produced a zinc concentration that was above the Contract Required Detection Limit (CRDL). Ordinarily, the sample results that are five times below the blank result are reported as undetected. The purpose of the low level zinc samples, however, was not necessarily to prove that a release had occurred, but to serve as background levels when determining the magnitude of release from the site. The magnitude of release was calculated by dividing the associated zinc level of the largest lead level by the associated zinc level of the smallest lead (i.e., background) level. If contamination of zinc occurred in all the samples at the same magnitude, or if only the low level samples were contaminated, then the values reported for the magnitude of release

are underestimated. The days on which the samples may have been contaminated are days four and five.

8.4.3 Analytical Results

Hi-vol samplers were set up on August 15, 1994. Actual operation of the hi-vol samplers began on August 17, 1994, and continued for three days. At the end of the third sampling day, heavy rains began to fall. The remaining two days of sampling were completed on August 23 and 24 after the area had dried out. The results for laboratory analysis of the air filters are included in Table 9.

The formulas used for determining the airborne concentrations are presented in Table 10, which shows the calculations used to determine the total volume of air sampled corrected to standard conditions by each sampler on each sampling day. This information was used to determine the average concentration per cubic meter for each of the elements of concern. When combined with wind speed and direction information from Figure 8, off-site migration of the contaminants can be determined. Table 11 shows the field increases for each day's samples comparing upwind and downwind concentrations and downwind versus background.

Day 1

The sampling period began at 1720 hours on August 16, 1994 with the start up of the hi-vol sampler at location HV-1. The last sampler was shut off at approximately 1830 hours on August 17, 1994. The wind rose for this period is shown on Figure 8. The predominant wind flow for this period was from the west-southwest at an average speed of 10.3 mph for 17% of the sample period; winds were from the southwest at an average speed of 8 mph for 26% of the sample period; and the wind was calm for 32% of the sampling period.

Samplers HV-1, HV-2 and HV-3 (CC-A-1, CC-A-6 and CC-A-11) were located at the College of the Canyons, the business development park, and at Mariposa Road, respectively, and were downgradient of dominant winds. These samplers were located on the edge of the tailings disposal area and had elevated lead levels for this sampling event.

Sampler HV-1 (CC-A-1), located at the College of the Canyons, had the highest lead level for this sampling event. With the dominant wind from the west-southwest, the source of lead was probably from the smelter stack area. HV-4 and HV-5 (CC-A-16 and CC-A-21) were in the secondary wind direction and located near the red piles. HV-4 and HV-5 served as the duplicate samplers and were placed side-by-side. The wind from the southwest would load these samples. Sampler HV-6 (CC-A-26) was also in the secondary wind direction and located at the Colorado State Forest Service office. The distance from the source area probably accounts for the relatively low lead levels in the sample. Samples HV-7 and HV-8 (CC-A-31 and CC-A-36) were located at the municipal waste transfer facility and at the auto salvage yard, respectively. These samplers were in the background, or windward, for this sampling event. Relatively low zinc and lead levels below the detection limit characterized these samples.

Zinc was used as a background indicator metal, as zinc occurred in measurable levels in all the air samples and was present in the background soil sample. The background lead samples for this day were below the detection limit at HV-7 and HV-8 (CC-A-31 and CC-A-36). Elevated lead levels were noted in the dominant and secondary wind directions indicating a release had occurred. The highest lead level was 0.072 $\mu g/m^3$ at the College of the Canyons (CC-A-1). Using the zinc values, associated with the highest and lowest lead samples as an indicator of the magnitude, the release was approximately 17 times the background levels (0.204 $\mu g/m^3$ / 0.012 $\mu g/m^3$). Sampler HV-6, located approximately one-half mile from the perimeter of the site tailings in the secondary direction, had a lead level of 0.006 $\mu g/m^3$, slightly above the laboratory detection limit (CC-A-26).

Day 2

The sampling period began at 1730 hours on August 17, 1994 with the start up of the hi-vol sampler at location HV-1. The last sampler was shut off at approximately 1840 hours on August 18, 1994. The wind rose for this period is shown on Figure 8. The predominant wind flow for this period was from the west-southwest at an average speed of 8.5 mph for 39% of the sample period; winds were from the southwest at an average speed of 8.8 mph for 34% of the sample period; and the wind was calm for 36% of the sampling period.

Samplers HV-1, HV-2 and HV-3 (CC-A-2, CC-A-7 and CC-A-12) were located at the College of the Canyons, the business development park, and at Mariposa Road, respectively, and were downgradient of dominant winds. These samplers were located on the edge of the tailings area and had elevated lead levels. Sampler HV-3 (CC-A-12), located at Mariposa Road, had the highest lead level for this sampling event. HV-4 and HV-5 (CC-A-17 and CC-A-22) were in the secondary wind direction and located near the red piles (HV-4 and HV-5 are collocated). The wind from the southwest would affect these samples. Sampler HV-6 (CC-A-27) was also in the secondary direction and was located at the Colorado State Forest Service office. The distance from the source area probably accounts for the relatively low lead levels for the sample. Samplers HV-7 and HV-8 (CC-A-32 and CC-A-37) were located at the municipal waste transfer facility and at the auto salvage yard, respectively. These samplers were in the background wind direction for this sampling event. These samples exhibited relatively low zinc and lead levels that were below the detection limit.

Zinc was used as a background indicator metal because it occurred in measurable levels in all the air samples and was present in the background soil sample. The background lead samples for this day were below the detection limit at HV-8 (CC-A-37) and HV-7 (CC-A-32). Elevated lead levels were noted in the dominant and secondary wind directions, indicating an off-site release. The highest lead level was 0.062 $\mu g/m^3$ at the Mariposa Road sampler HV-3 (CC-A-12). Using the zinc values, associated with the highest and lowest lead samples, as an indicator of the magnitude, the release was approximately 3.5 times the background levels (0.046 $\mu g/m^3$ / 0.013 $\mu g/m^3$). Sampler HV-6, located approximately one-half mile from the perimeter of the site tailings in the secondary direction, had a lead level of 0.005 $\mu g/m^3$, slightly above the laboratory detection limit (CC-A-27).

Day 3

The sampling period began at 1745 hours on August 18, 1994 with the start up of the hi-vol sampler at location HV-1. The last sampler was shut off at approximately 1900 hours on August 19, 1994. The wind rose for this period is shown on Figure 8. Erratic and gusty winds characterized the weather pattern for this day's sampling event. Sustained (15 minute average) winds of 12.5 mph were noted. The predominant wind flow for this

period was from the southwest at an average speed of 8.6 mph for 24% of the sample period; wind was from the west-southwest at an average speed of 6.7 mph for 28% of the sampling period; and the wind was calm for 26% of the sampling period.

Samplers HV-2 and HV-3 (CC-A-8 and CC-A-13) were located at the business development park and at Mariposa Road, respectively, and were downgradient of dominant winds. These samplers were located on the edge of the tailings area and had elevated lead levels. Also in the dominant wind direction were HV-4 and HV-5 (CC-A-18 and CC-A-23) which were located near the red piles (HV-4 and HV-5 are collocated). Sampler HV-6 (CC-A-28) was also in the dominant direction and was located at the Colorado State Forest Service office. The distance from the source area probably accounts for the relatively low lead levels noted in the sample. Sampler HV-3 (CC-A-13) was located at the Mariposa Road and had the highest lead level for this sampling event. Sampler HV-8 (CC-A-38), located at the auto salvage yard, was in the background wind direction for this sampling event. Relatively low zinc and lead levels below the detection limit characterize this sample. The sampler at the municipal waste transfer facility, HV-7, had slightly elevated lead and zinc values near the values found for sampler HV-4 and HV-5 (CC-A-18 and CC-A-23). The erratic and gusty winds may account for the loading of this sampler.

Zinc was used as a background indicator metal because it occurred in measurable levels in all the air samples and was present in the background soil sample. The background lead sample for this day was below the detection limit at HV-8 (CC-A-38). Elevated lead levels were noted in the dominant and secondary wind directions indicating an off-site release did occur. The highest lead level was 0.044 $\mu g/m^3$ at the Mariposa Road sampler HV-3 (CC-A-13). Using the zinc values, associated with the highest and lowest lead samples, as an indicator of the magnitude, the release was approximately 2.3 times the background levels (0.040 $\mu g/m^3$ / 0.017 $\mu g/m^3$). Sampler HV-6, located approximately one-half mile from the perimeter of the site tailings in the dominant direction, had a lead level below laboratory detection limit (CC-A-27).

Day 4

The sampling period began at 1115 hours on August 23, 1994 with the start up of the hi-vol sampler at location HV-1. The last sampler was shut off at approximately 1215 hours

on August 24, 1994. The wind rose for this period is shown on Figure 8. Winds from the northeast and southwest characterized the weather pattern for this day's sampling event. The predominant wind flow for this period was from the northeast at an average speed of 8 mph for 14% of the sample period; winds were from the west-southwest at an average speed of 7 mph for 14% of this sample period; and the wind was calm for 34% of the sampling period.

No hi-vol samplers were downgradient of dominant winds for this day's sampling. Samplers HV-1, HV-2 and HV-3 (CC-A-4, CC-A-9 and CC-A-14) were located at the College of the Canyons, the business development park, and at Mariposa Road, respectively, and were in the secondary wind direction. These samplers were located on the edge of the tailings area and had elevated lead levels. Sampler HV-3 (CC-A-14) had the highest lead level for this sampling event at 0.065 $\mu g/m^3$. In a peripheral wind direction were HV-4 and HV-5 (CC-A-19 and CC-A-24) which were located near the red piles (4 and 5 are collocated). Sample HV-6 (CC-A-29) was also in the peripheral direction and was located at the Colorado State Forest Service office. The distance from the source area probably accounts for the relatively low lead levels noted in the sample. Samples HV-7 and HV-8 (CC-A-34 and CC-A-39) were located at the municipal waste transfer facility and at the auto salvage yard, respectively. These samplers were in the background wind direction for this sampling event. These samples exhibited relatively low zinc and lead levels that were below the detection limit.

Zinc was used as a background indicator metal because it occurred in measurable levels in all the air samples and was present in the background soil sample. The background lead samples for this day were below the detection limit at HV-8 (CC-A-39) and HV-7 (CC-A-34). Elevated lead levels were noted in the secondary and peripheral wind directions, indicating that a release off site occurred. The highest lead level was at the Mariposa Road sampler HV-3 (CC-A-14) at 0.065 $\mu g/m^3$. Using the zinc values, associated with the highest and lowest lead samples as an indicator of the magnitude, the release was approximately 3.3 times the background level (0.079 $\mu g/m^3$ / 0.024 $\mu g/m^3$). Sampler HV-6, located approximately one-half mile from the perimeter of the site tailings in the peripheral direction, had a lead level of 0.007 $\mu g/m^3$, slightly above the laboratory detection limit (CC-A-29).

Day 5

The sampling period began at 1120 hours on August 24, 1994 with the start up of the hi-vol sampler at location HV-1. The last sampler was shut off at approximately 1220 hours on August 25, 1994. The wind rose for this period is shown on Figure 8. Strong winds from the east-northeast and southwest characterized the weather pattern for this day's sampling event. The predominant wind flow for this period was from the southwest at an average speed of 12 mph for 28% of the sample period; winds were from the east at an average speed of 14.5 mph for 9% of the sampling period; and the wind was calm for 21% of the sampling period.

Samplers HV-2, HV-3, HV-4, HV-5, and HV-6 (CC-A-10, CC-A-15, CC-A-20, CC-A-25, and CC-A-30) were located at the business development park, at Mariposa Road, at the red piles (HV-4 and HV-5 were placed side by side) and at the Forest Service office, respectively, and were downgradient of dominant winds. Samplers HV-2, HV-3, HV-4, and HV-5 were located on the edge of the tailings area and had elevated lead levels. Sampler HV-6 (CC-A-30) was located at the Colorado State Forest Service office. The distance from the source area probably accounts for the relatively low lead level noted in this sample. Sampler HV-3 (CC-A-15) was located at Mariposa Road and had the highest lead level for this sampling event at 0.099 $\mu g/m^3$. Sampler HV-7 (CC-A-35), located at the Municipal waste transfer facility, was in the peripheral direction and had a slightly elevated lead level (0.011 $\mu g/m^3$). Sampler HV-8 (CC-A-40) was located at the auto salvage yard and was in the secondary wind direction for this sampling event. Because this sample exhibited relatively low zinc and lead levels that were below the detection limit, it was used as a background sample.

Zinc was used as a background indicator metal because it occurred in measurable levels in all the air samples and was present in the background soil sample. The background lead sample for this day was below the detection limit at HV-8 (CC-A-40). Elevated lead levels were noted in the dominant and secondary wind directions indicating an off-site release did occur. The highest lead level was at the Mariposa Road sampler HV-3 (CC-A-15) at 0.099 $\mu g/m^3$. Using the zinc values, associated with the highest and lowest lead samples, as an indicator of the magnitude, the release was approximately 4.3 times the background levels (0.073 $\mu g/m^3$ / 0.017 $\mu g/m^3$). Sampler HV-6, located approximately one-half mile

from the perimeter of the site tailings in the dominant direction, had a lead level below laboratory detection limit (CC-A-30).

8.5 Conclusions

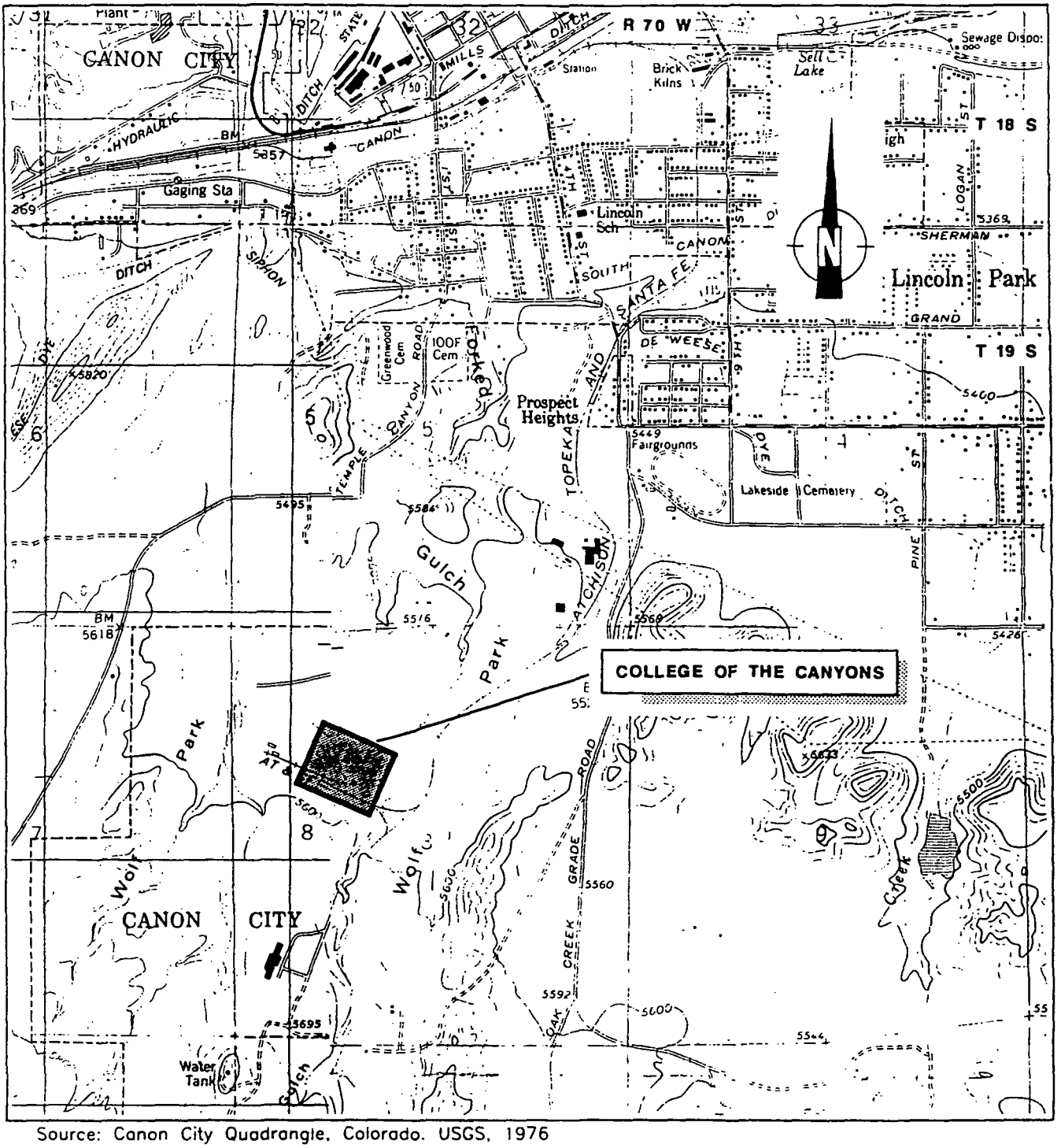
The analytical data suggest that a release of contaminants occurs via the air migration pathway. The lead released off-site exceeded the minimum values detected in the background samples for each day. The highest recorded level was 0.099 $\mu g/m^3$ lead on the fifth day of sampling. Of the eight hi-vol stations, five recorded detectable levels of lead for all five sampling days. The five stations were located at the College of the Canyons, the Fremont County Business Development Park, near Mariposa Road, and near the red tailing piles just north of the site. Two of the hi-vol samples, located at the Colorado State Forest Service Shops and at the BFH Transfer Station, recorded detectable levels of lead on some days, but not on others. The hi-vol station located at the Fremont Auto Salvage yard failed to detect lead on any of the sampling days.

9.0 SUMMARY AND CONCLUSIONS

Off-site releases were observed for the surface water pathway. Releases to the surface water pathway, however, were confirmed only for Forked Gulch, while releases to the Arkansas River could not be substantiated. Lead, arsenic, and cadmium were all detected in the surface water samples along Forked Gulch at levels three times above their respective background levels. Lead, arsenic, cadmium, and mercury were detected in sediment samples along Forked Gulch at levels confirming an off-site release. Other metals released but which are not as large a toxicological concern or were not present at relatively high concentrations, are antimony, cobalt, chromium, copper, iron, manganese, nickel, vanadium, and zinc. Technically, a release into the Arkansas could not be substantiated, but based upon samples collected from near the confluence of the Arkansas River and Forked Gulch, it is probable that metals are entering the Arkansas River. Due to the flow of the Arkansas River, metal-laden sediments are dispersed and contaminated water is diluted.

The hi-vol sampling indicated that a release is occurring to the air pathway. Targets that are consistently located in the pathway are workers at the Fremont County Business

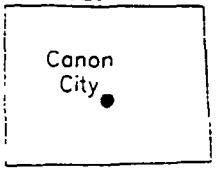
Development Park and at the College of the Canyons. Based on the results of the BFH Transfer Station and the Colorado State Forest Service the extent to which the release travels is limited. The hi-vol sampler located at the Fremont Auto Salvage yard, which did not detect the presence of lead, further indicates that lead migrating through the air is limited and also dependent upon the direction of the prevailing winds.



Source: Canon City Quadrangle, Colorado. USGS, 1976

0 1/2 1 MILE

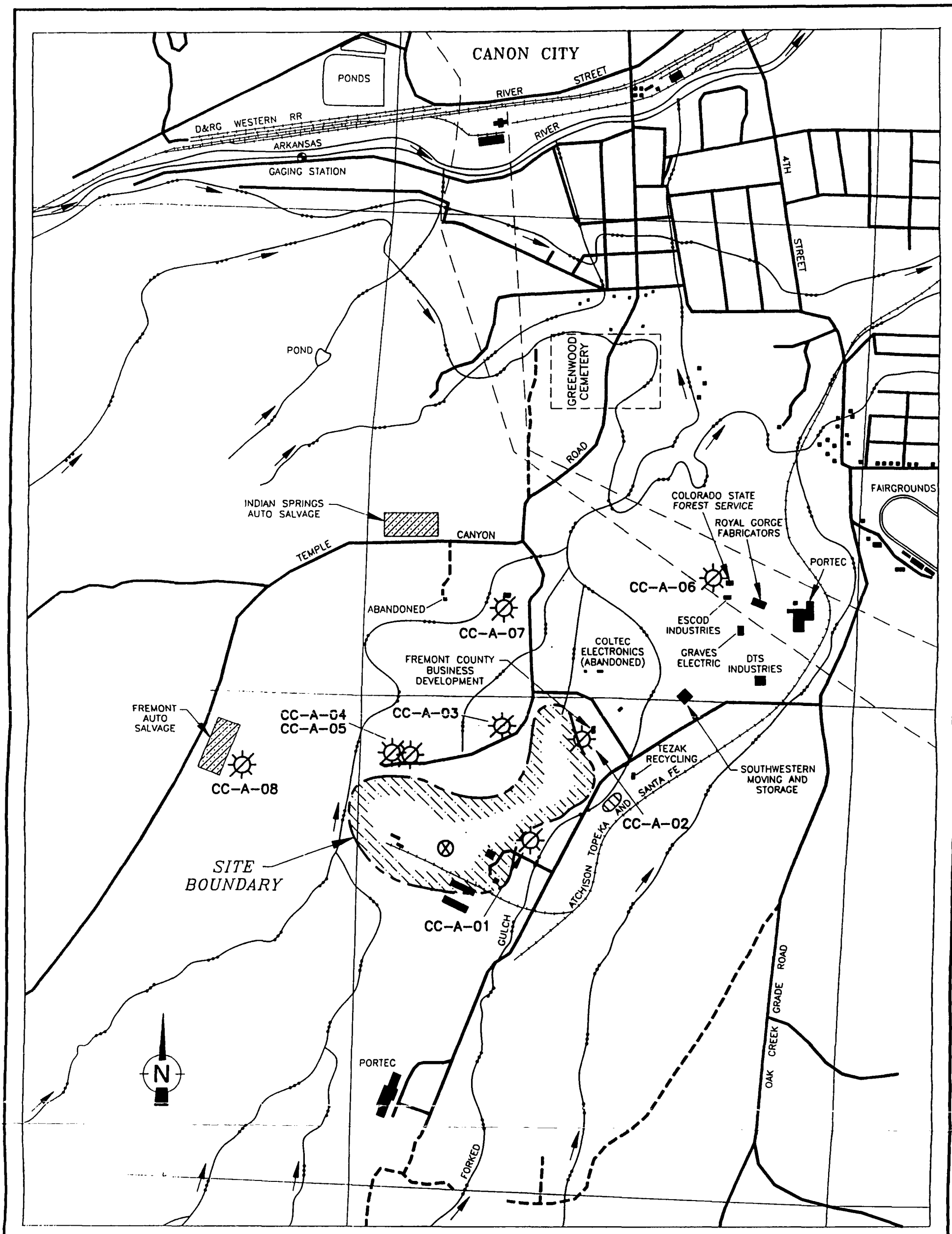
LOCATION MAP
COLORADO



LEGEND

Site location

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION EPA CONTRACT 68-WO-0037	
TITLE: COLLEGE OF THE CANYONS Canon City, Colorado SITE LOCATION MAP	
T.D.D. T08-9406-0501	ZTCOLCAN
ecology & environment, inc. DENVER, COLORADO	FIG. 1
Date: 07/06/94 Drawn by: RSM Scale:	


CANON CITY
PONDS
RIVER
STREET
D&RG WESTERN RR
RIVER
ARKANSAS
GAGING STATION
4TH
STREET
POND
GREENWOOD CEMETERY
ROAD
FAIRGROUNDS
COLORADO STATE FOREST SERVICE
ROYAL GORGE FABRICATORS
PORTEC
INDIAN SPRINGS AUTO SALVAGE
CANYON
TEMPLE
CC-A-06
ABANDONED
CC-A-07
ESCOD INDUSTRIES
COLTEC ELECTRONICS (ABANDONED)
GRAVES ELECTRIC
DTS INDUSTRIES
FREMONT COUNTY BUSINESS DEVELOPMENT
FREMONT AUTO SALVAGE
CC-A-04
CC-A-05
CC-A-03
TEZAK RECYCLING
SOUTHWESTERN MOVING AND STORAGE
SANTA FE
ATCHISON TOPEKA AND
CC-A-02
CC-A-08
SITE BOUNDARY
CC-A-01
GULCH
GRADE ROAD
OAK CREEK
PORTEC
FORKED
N
0
1000
2000
3000
SCALE : FEET
LEGEND
Air sample location
Met. station
TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0037
TITLE:
COLLEGE OF THE CANYONS
Canon City, Colorado
HIVOL SAMPLE LOCATION MAP
T.D.D. T08-9406-0501
ZTCOLCA5
ecology & environment, inc.
DENVER, COLORADO
FIG. 2
Date: 09/22/94 Drawn by: RSM Scale:

R 70 W

T 19 S

CANON CITY

MARIPOSA ROAD

CANON CITY

GULCH

FORKED GULCH

VALLEY ROAD

FORGE ROAD

ATCHISON TOPEKA AND SANTA FE

CITY LIMITS

CITY LIMITS

GULCH

DIRT ROAD

SETTLING POND

PIT

STANDING WATER

TAILINGS

TAILINGS

TAILINGS

STANDING WATER

WA-01

WA-02

CC-XRF-49

52-53

BUILDINGS

STACK

COLLEGE OF THE CANYONS

FORMER FURNANCE LOCATION

BUILDINGS

RR SPUR

DIRT ROAD

FORGE ROAD

6 5
7 8

18
103
19
50
11
49
51
52-53
16
15,45
48
12
54
2,44
1
3
47
4
13,43
14
55
34
39
38
33
46
37
32
36
31
35
30
29
17
27
28
26
101
5
6
23
21
22
24,42
25
20
104
102
9
8
10
40,41

0 200 400 800

SCALE : FEET

N

LEGEND

▼ Soil XRF sample location

◉ Water sample location

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0037

TITLE:

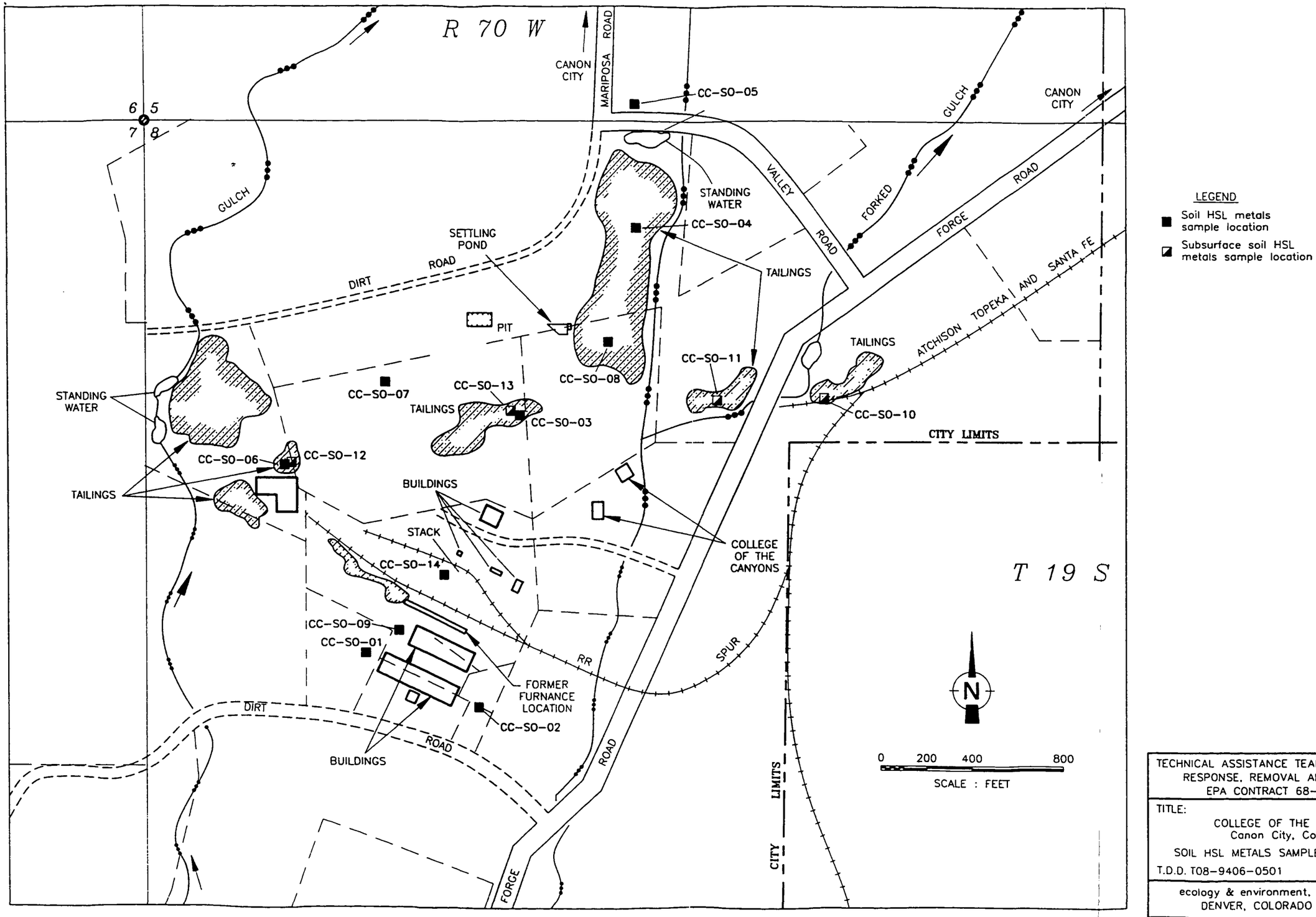
COLLEGE OF THE CANYONS
Canon City, Colorado
SOIL XRF SAMPLE LOCATION MAP

T.D.D. T08-9406-0501 ZTCOLC10

ecology & environment, inc.
DENVER, COLORADO

FIG. 3

Date: 09/13/94 Drawn by: RSM Scale:



TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0037

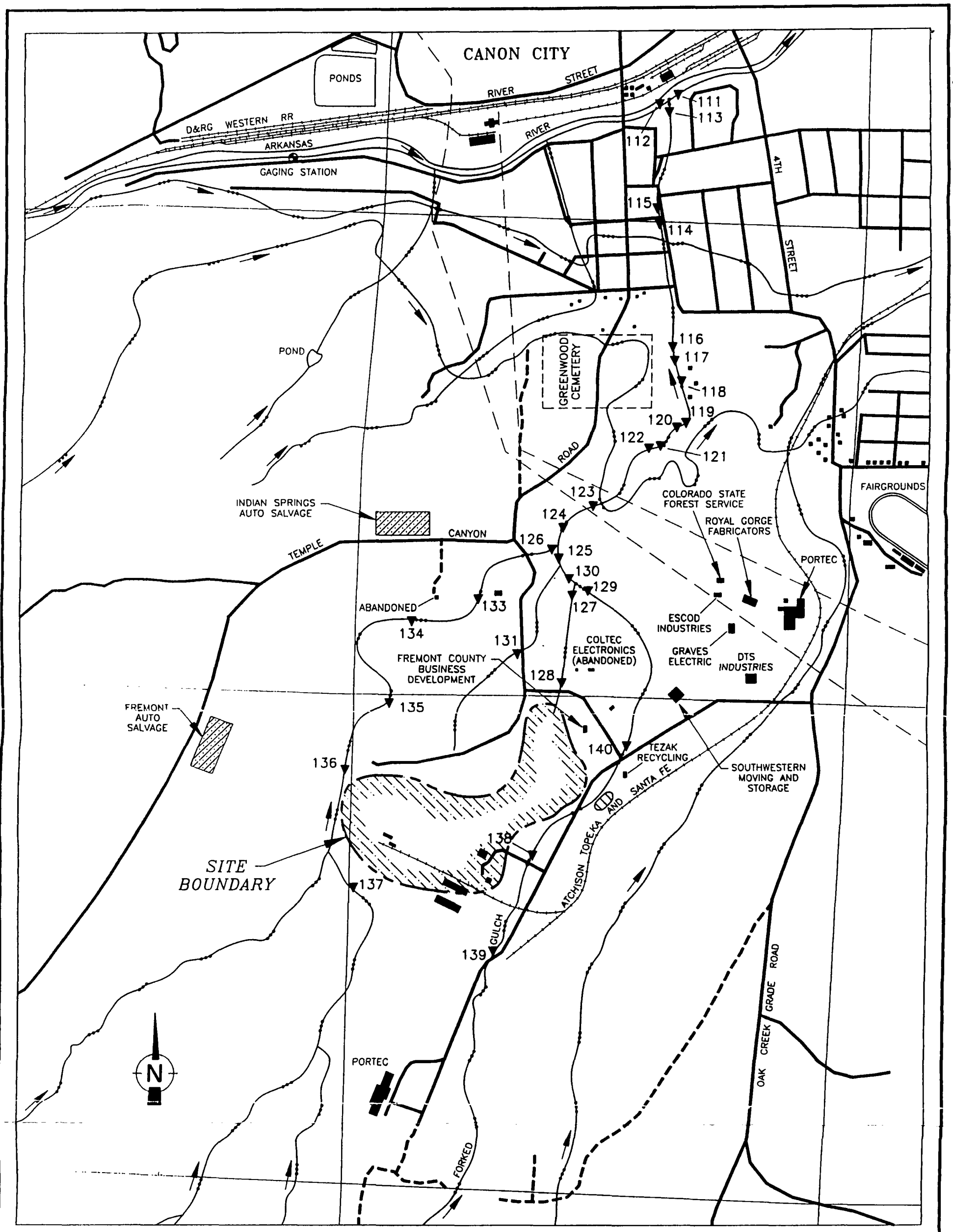
TITLE:
COLLEGE OF THE CANYONS
Canon City, Colorado
SOIL HSL METALS SAMPLE LOCATION MAP

T.D.D. T08-9406-0501 ZTCOLC10

ecology & environment, inc.
DENVER, COLORADO

FIG. 4

Date: 09/13/94 Drawn by: RSM Scale: _____



TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0037

TITLE:
COLLEGE OF THE CANYONS
Canon City, Colorado
SEDIMENT XRF SAMPLE LOCATION MAP

T.D.D. T08-9406-0501 ZTCOLCA5

ecology & environment, inc.
DENVER, COLORADO

FIG. 5

Date: _____ Drawn by: RSM Scale: _____

CANON CITY

PONDS

RIVER STREET

D&RG WESTERN RR

RIVER

ARKANSAS

GAGING STATION

CC-SE-15

CC-SE-14

CC-SE-16

CC-SE-13

4TH STREET

POND

GREENWOOD CEMETERY

CC-SE-12

ROAD

CC-SE-11

CC-SE-10

COLORADO STATE FOREST SERVICE

FAIRGROUNDS

INDIAN SPRINGS AUTO SALVAGE

CANYON

TEMPLE

CC-SE-09

CC-SE-06

CC-SE-04

ROYAL GORGE FABRICATORS

PORTEC

ABANDONED

CC-SE-08

ESCOD INDUSTRIES

CC-SE-05

COLTEC ELECTRONICS (ABANDONED)

GRAVES ELECTRIC

DTS INDUSTRIES

FREMONT COUNTY BUSINESS DEVELOPMENT

FREMONT AUTO SALVAGE

CC-SE-03

TEZAK RECYCLING

SOUTHWESTERN MOVING AND STORAGE

CC-SE-07

ATCHISON TOPEKA AND SANTA FE

SITE BOUNDARY

CC-SE-01

CC-SE-02

GULCH

GRADE ROAD

OAK CREEK

N

PORTEC

FORKED

0 1000 2000 3000

SCALE : FEET

▲ Sediment HSL metals sample location

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0037

TITLE:
COLLEGE OF THE CANYONS
Canon City, Colorado
SEDIMENT HSL METALS
SAMPLE LOCATION MAP

T.D.D. T08-9406-0501 ZTCOLCA5

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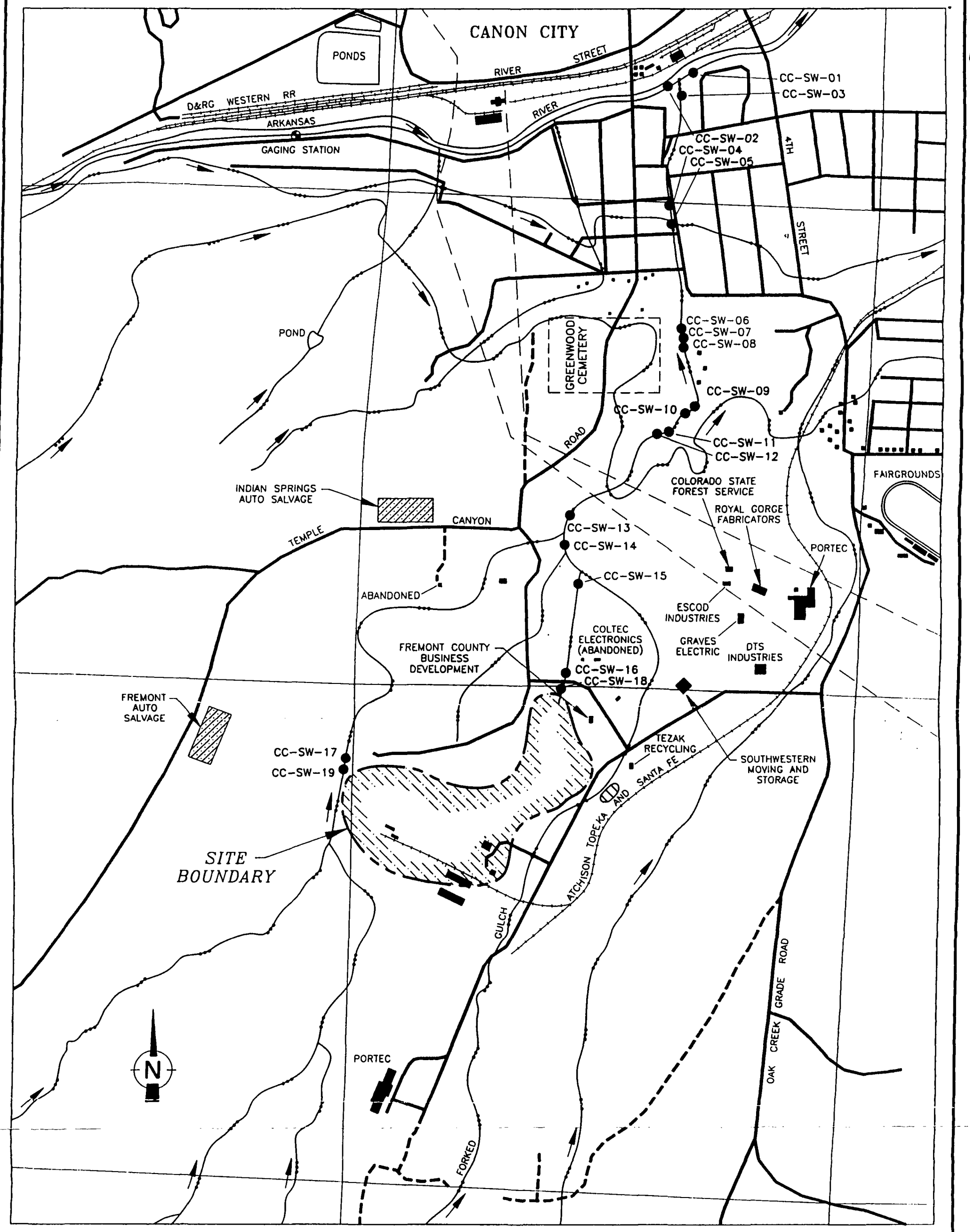
FIG. 6

Date: _____ Drawn by: RSM Scale: _____



TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE, REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0037

TITLE:
COLLEGE OF THE CANYONS
Canon City, Colorado
SURFACE WATER SAMPLE LOCATION MAP

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FIG. 7

Date: 08/12/94 Drawn by: RSM Scale: _____